

# **The Effects of an Undergraduate Nursing Informatics Curriculum on Students' Knowledge and Attitudes**

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*This paper describes the fourth stage of a process to design, implement and evaluate the nursing informatics courses incorporated into a baccalaureate nursing program. The challenge is to structure the nursing informatics curriculum so as to provide the nursing professional with the basis with which to impact health care delivery. The basic components of the framework are information, technology, and clinical care process. Students in the fourth course worked closely with agency personnel to design, implement and evaluate clinical application projects.*

Preparing health care professionals to utilize information technology is a challenge that needs to be addressed by educational programs. Therefore this paper will describe the design, implementation and evaluation an integrated informatics curriculum currently in place in a baccalaureate nursing program. First time implementation of the fourth course of a required four course sequence will be discussed as well as the ongoing evaluation of the first, second and third courses of the curriculum.

## **BACKGROUND AND REVIEW**

In the Fall of 1990, the inaugural class of a new baccalaureate program in nursing was admitted. Previous to the admission of the first class of this new program, nursing educators recognized an opportunity to formally incorporate information science into a university curriculum through a required sequence of four courses. Preparation of nursing professionals to face the challenges of health care in the 21st century rests on educational programs well grounded in the sciences that support nursing. Increase in the use of computer technology and information science in nursing practice, education, and administration demands a new approach in the preparation of nurses for the use of information technology [3,11]. However, the ability to implement the necessary changes in curriculum to address the demands of complex clinical practice characterized by escalating information management

challenges is difficult [2,3]. Additionally, the report of Priority Expert Panel E: Nursing Informatics [6] continually challenges faculty to produce a baccalaureate graduate who utilizes information technologies in their clinical judgement to improve the patient care process and join the cadre of nursing professionals needed to change health care.

Of particular interest to this audience is the innovative inclusion of nursing informatics throughout the four years of baccalaureate curriculum. Other key aspects of the program include a focus on acute and critical care nursing, a bedside nursing emphasis, strong clinical experience throughout all four years beginning in the first semester of the curriculum, a development of identity with professional nursing through personal link-ups with nurses in clinical settings, and well defined linkages to the three consortium hospitals that provide the clinical experiences for the students. Each student is placed in a single clinical site for the entire four-year educational program which allows the student to become integrated in the organizational culture and social climate of the hospital.

## **CHALLENGE**

The implementation of the fourth course placed in the last semester of the fourth year of the program provided the following challenges:

- 1) To assist the students to view the integration of information technology as a tool in support of the patient care process in the broader venue of health care.
- 2) To develop and implement the fourth course and closely align it with other nursing courses.

## **DESIGN**

In the development of the curriculum, we faced a challenge to produce a new type of university graduate destined for excellence in clinical practice in acute and critical care through effective use of information technologies. Argyris and Schon [1]

suggest that the clinical field experience in a professional nursing program should not be designed merely to give students experience in the real clinical setting to learn accepted practices, but should also provide the student with the opportunity to try out new approaches and modalities of care. In addition, the recommendations set forth by Peterson & Gerdin-Jelger [8] and Ronald & Skiba [10] were reviewed for guidance in the design.

Consequently, the nursing informatics courses are designed to articulate with the clinical experience and comprehensive course progression followed by the baccalaureate students. The three basic components of the model identified to provide a framework are information, technology, and clinical care process. A model was developed to illustrate the three aspects of nursing informatics in the undergraduate curriculum (See Figure 1). Each of the four courses address the three components, however, the emphasis regarding each component is dependent on the specific course. In order to successfully focus the curriculum, faculty consciously worked to develop all nursing courses whereby nursing informatics and nursing science theories would be integrated throughout the curriculum. There is a total of 122 credits in the undergraduate nursing curriculum. Seven credits are in the required informatics sequences. Of the 122 credits required, 81 are nursing credits.

The first course in the sequence is Introduction to Nursing Informatics (2 credits). The emphasis is on information and technology with an overlap in the clinical care process (see Figure 1). This course focuses on helping students identify the content, flow and processing of patient information within the hospital [12]. In Nursing Informatics II (1 credit), the primary emphasis is on information and the clinical care process with secondary emphasis on technology (see Figure 1). This course prepares the student to handle the increased quantitative information encountered in the clinical area [13,14]. In the third course, Nursing Informatics III: Clinical Nursing Information Systems (2 credits), the focus is on the overlap of the three components: information, technology, and clinical care process (see figure 1). The emphasis is on the use of information technologies to support nursing management in clinical applications [14]. The culminating course in the nursing informatics sequence is Nursing Informatics IV: Applications (2 credits). This course is designed to provide hands-on experience for the student in selected areas of application in nursing informatics. The course is conducted as a project-based course, in

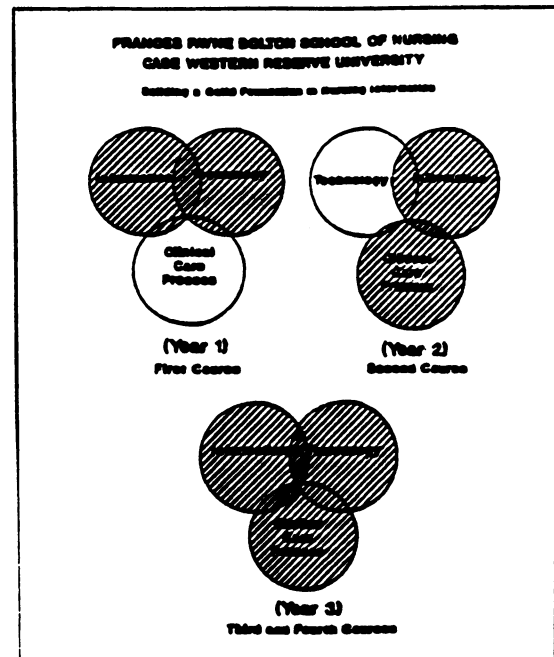


Figure 1

which students are grouped into teams of five-to-seven members to work on agency-specified projects. Our curriculum reflects the advances in technologies and demands of the marketplace as outlined in Neighbors & Eldred [7] and reported by those who have endorsed specific level requirements for informatics in baccalaureate and graduate educational programs [3,4,9].

It is important to acknowledge the ability to implement these courses is in part due to the fact that the Case Western Reserve University has a well developed fiberoptic network (CWRUNET) that supports a variety of teaching strategies. Students can access the university network from student, laboratories and from their dormitory rooms. If they have a computer each dormitory room is equipped with a faceplate giving them immediate access to the network. From previous surveys, we found that approximately 60% of incoming freshmen owned computers [12,13]. On the other hand, the consortium hospitals are all in the process of selecting a nursing information system. Therefore, students continue to have varied opportunities to observe applications in the nursing practice environment.

## IMPLEMENTATION

The projects that formed the core activities of Nursing Informatics IV were projects that originated in the consortium hospitals and met needs emergent within the hospital environment. In addition, for the purposes of learning nursing informatics, the previously explained long-term relationship of the

students with the clinical agency help students better understand the nature of information management within the agency, and meaningfully participate in informatics projects. To initiate project design, the course instructor met with key personnel in each of the participating agencies. These personnel included nurse administrators, clinical nurse specialists, and information systems coordinators. The concept of nursing informatics projects was explained to encompass any work required to enhance nurses' ability to obtain, manage, store, or manipulate the data and knowledge necessary for practice. Agency personnel were asked to identify 4-6 projects per hospital, and to provide the following information for each project: Project title, objectives, deliverables, special considerations, and deadlines. Projects requiring approximately six-weeks of work (about 200 person-hours) were sought.

Nineteen suitable projects were identified from the three consortium hospitals. Listed below is a sample of the project activities:

- 1) Develop a scantron-form for recording the critical path of patients with cardiac surgery.
- 2) Construct a database to help a nurse practitioner-lactation consultant manage her practice.
- 3) Propose a data access policy for a large university teaching hospital.
- 4) Create a database to enable staff on a psychiatric inpatient service to conduct follow-up on patients.
- 5) Generate charts and graphs from a mainframe-stored hours-worked data set.
- 6) Devise a database and screening system to predict patients at risk for discharge planning challenges.
- 7) Establish the information flow of an out-patient ultrasonography service.
- 8) Provide off-hours backup and training support for a hospital bringing up a new hospital information system.
- 9) Define the information requirements necessary to support a continuous quality improvement project.

The projects varied in terms of the extent of computing skill necessary to conduct the work, and the amount of face-to-face interaction required to complete the tasks. Some informatics projects had absolutely no need for computer systems; others, such as the database creation activities, required specific computer skills. All of the projects challenged students to work with an agency staff member to define project deliverables, to interact with peers in a task-focused manner, and to apply prior nursing informatics knowledge to solve real-world problems.

After reviewing the projects available within their respective agencies, students within each consortium hospital group self-selected into project teams. Students participated in four class sessions in which the content focused on team building, project planning, and organizational communication. Under the direction of the course instructor, students spent six weeks preparing a project work plan and obtaining the necessary skills and materials to carry out the work plan. Once a project team received written approval from the course instructor and the agency contact person, the team implemented the work plan.

Students' teams provided weekly electronic mail updates of project status to the course instructor. Addressed in each e-mail message were the progress towards objectives, accomplishments of the week, and any obstacles to progress with a plan for managing the obstacles. The course instructor provided weekly feedback. Each project team also maintained a three-ring binder of materials related to the project, including background reading and drafts of work. These binders were kept in a public place accessible to all students.

## EVALUATION - NURSING INFORMATICS IV

Seventeen of the 19 projects were initiated and completed within the academic semester. Two of the projects were withdrawn by the agencies before work had begun. Students presented the results of their projects to classmates and selected faculty through a variety of methods i.e. posters with detailed explanation of output presented, demonstration of developed programs on computers, and presentation of deliverables agreed on by project group. Students' reactions to the projects were predictably mixed: many students voiced pleasure at their own skill in nursing informatics, some evaluated the projects as being 'not clinical', and therefore not relevant to their work. In addition, students reported that due to a variety of reasons, it appeared that the outcome from some of the projects might not be operationalized immediately which was somewhat disappointing to them. However, the agency personnel interacting with the student groups were very complimentary and appreciative of the efforts of the groups.

## UPDATE ON INFORMATICS I, II, III

The students continue to value the self-paced computer simulation packages used in Nursing

Informatics and other nursing courses. These packages require students to use the technology. Specifics of the packages have been discussed in previous articles [13, 14]. Assignments continue to reflect application of information technology to patient situations.

## PROGRAM EVALUATION

This is the fourth stage of a longitudinal study that has extended over a four year period. Evaluation of outcomes with respect to both students' attitudes and knowledge acquired has occurred after each stage. In addition to following the first cohort of students through the four year period, a comparison between the first group of students and succeeding student cohorts will occur. At the end of the present courses, the survey previously developed [13] to evaluate the students' knowledge and attitudes toward computers and nursing informatics has been readministered so that an ongoing evaluation of changes in knowledge and attitude has been captured.

The instrument to be used for this study is a 30 item questionnaire adapted from McConnell, O'Shea, and Kirchhoff [5], to measure knowledge and attitudes toward computers. Students rate each item on a five point Likert scale. Factor analysis on the first sample supported a three factor structure and deletion of six items. The three scales are scientific use of technology, common misconceptions associated with technological advances, and clinical care process. The scientific use scale is composed of four items regarding the advantages of computer technology in the health care setting. Higher scores indicate more positive knowledge and attitudes. Cronbach's alpha for the scale is .58. The common misconceptions scale has eight items which describe commonly held fears and concerns regarding advances in technology in the workplace. Lower scores indicate more negative knowledge and attitudes. Cronbach's alpha was .83. The 12-item clinical care scale addresses the application of technology to support the nurse in providing patient care. Higher scores indicate more positive knowledge and attitudes. Cronbach's alpha was .85.

Each cohort was assessed at the end of each academic year on knowledge and attitudes. Data analysis was conducted to answer two research questions: 1) Do students' responses change after completion of each of the four courses? and 2) Are students' responses following each course different for each cohort? Ratings for the first cohort after each of the four

courses were compared with oneway Analysis of Variance (ANOVA) and Scheffe tests for post-hoc comparisons. Repeated measures analysis is not possible as we collected data in a way to maintain anonymity for students. Their scores on the Clinical Care Process scale were significantly lower after the fourth course than after each of the other three courses,  $F(3, 272) = 8.43, p < .001$ . Differences on the Scientific Use and Common Misconceptions scales were not significant,  $F(3, 277) = 1.38, p = NS$  and  $F(3, 278) = 1.80, p = NS$ , respectively. The lower scores on Clinical Care Process after the fourth course likely represent the students' attempts at responding to the "gap between education and practice" [11]. Indeed, scores on this scale were significantly lower for each subsequent year, indicating a continuing process of reconciling the theoretical content presented in class with the reality of the clinical setting.

This finding is consistent with our previous analysis with this group of students [14]. Obtaining differences on this scale and not on the other two may indicate that the Scientific Use and the Common Misconceptions scales represent a broader base; that is, the knowledge and attitudes tapped by these two scales are less central to the daily clinical reality and, thus, are less influenced by the education-practice gap.

To address the second research question, a series of oneway ANOVAs with Scheffe tests were used to compare students' ratings after the first, second, and third informatics courses across cohorts. In the comparisons of scores after the first course, the fourth cohort (current freshmen) had significantly lower scores on the Clinical Care Process scale than each of the other cohorts,  $F(3, 306) = 12.30, p < .001$ . The other two scales were not significantly different across cohorts. In the comparisons of scores after the second and third courses, none of the cohorts were significantly different on any of the three scales. There are several possible reasons for the finding. First, some changes were made to the first course based on our experience with previous classes. Specifically, the source of readings was changed from primarily articles to primarily textbook. In addition, increased emphasis was placed on electronic communication, which may have diminished attention on clinical applications. Second, the timing of administration of the instrument was changed with the fourth group. In the three previous cohorts, we had students complete the instrument upon entering the first course so that we

could evaluate the level and content of this first course. These three previous cohorts gave us sufficient data about our students' sophistication with information technology to identify the appropriateness of the course plan and the teaching strategies. However, it is possible that this pretest served to direct students' interest or attention to the application of information technology to the clinical setting, thus increasing their overall knowledge and attitude level. If so, this change in measurement protocol may have resulted in students' in the fourth cohort having lower scores than their predecessors. These findings are consistent with the third reason, that students integrate information obtained in the classroom with experience in the clinical area. Thus, students' knowledge and attitudes about nursing informatics becomes less idealistic and more practical with increasing exposure to the clinical arena.

### SUMMARY

The challenges of equipping nursing professionals for delivery of health care in the 21st century are many. However by incorporating information technology in the didactic and clinical portions of courses, faculty have ensured a blend of information, technology, and the clinical care process. Consistent with the results obtained after the students completed the third course, student scores on the clinical care process scale continued to decrease. The students' ability to complete complex application projects suggest they do indeed have the skills and knowledge to use information technology in the clinical setting. This ability in conjunction with the scores supports our previous hypothesis that students are reconciling the education-practice gap through application of their critical thinking skills.

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